

REMARKS

Applicants respectfully request reconsideration of the Office Action mailed January 3, 2005. Claims 10-14 and 25 are presented for examination. Claim 25 has been amended. The amendment to Claim 25 is fully supported by the specification and drawings as originally filed. Specifically, amended Claim 25 is supported by Figure 2 and by the specification at paragraph [0028]. No new matter has been added.

Applicants respectfully submit that the amendment presented herein places the claims in condition for allowance, or at least in better form for consideration on appeal, and therefore respectfully request entry of this amendment.

Rejection of Claims 25 and 11-13 under 35 U.S.C. §102(e) over Dubin

Claims 25 and 11-13 are rejected under 35 U.S.C. §102(e) as being anticipated by U.S. Patent Application Pub. No. 2004/0108217 by Dubin. Applicants respectfully traverse this rejection.

Claim 25 is directed to an interconnect structure formed on a substrate. An embodiment of this interconnect structure is illustrated in Figure 2. For the convenience of the Examiner, Claim 25 is described herein with reference to the features shown in Figure 2. The structure comprises a first layer of a first dielectric material (10) having at least one first conductor (13) embedded therein, and a second layer of a second dielectric material (15) overlying the first layer of dielectric material (10) and having at least one second conductor (19, 21) embedded therein. The first conductor (13) has a top surface coplanar with a top surface of the first layer of dielectric material (10). The second conductor comprises at least one first portion (19) and at least one second portion (21), wherein the first portion (19) is in electrical contact with the first conductor (13), the second portion (21) is overlying and in electrical contact with the first portion (19), the second portion (21) has a lateral extent greater than that of the first portion (19), and the second portion (21) has a top surface coplanar with a top surface of the second layer of dielectric material (15). The

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interconnect structure also comprises a first conductive liner (20) disposed on an underside and sidewalls of both the first portion (19) and the second portion (21) of the second conductor, and a second liner (18) disposed on an underside and sidewalls of only the first portion (19) of the second conductor. Thus, it is a feature of the present invention that a first conductive liner is disposed on an underside and sidewalls of both a first portion and a second portion of the second conductor, while a second liner is disposed on an underside and sidewalls of only the first portion of the second conductor. In other words, two liners (18, 20) are disposed on an underside and sidewalls of the first portion (19) of the second conductor, while only one liner (20) is disposed on an underside and sidewalls of the second portion (21) of the second conductor. Applicants respectfully submit that this feature of the present invention is not disclosed by Dubin, as follows.

The Dubin patent is directed to copper interconnect structures formed by co-plating of noble metals. In Figure 2, copper conductor 112' is shown surrounded on the underside and sidewalls only by barrier layer 108'. Notably, this is the only layer disposed on the underside and sidewalls of all portions of conductor 112', with no distinction between a first portion and a second portion. In other views of the Dubin structures, such as in Figure 1e, copper conductor 112 is shown surrounded on the underside and sidewalls by barrier layer 108 and seed layer 110. Both of these layers, however, are disposed on the underside and sidewalls of all portions of conductor 112, again with no distinction between a first portion and a second portion. Dubin, therefore, discloses a first liner disposed on an underside and sidewalls of both a first portion and a second portion of a conductor, but fails to disclose a second liner disposed on an underside and sidewalls of only the first portion of the conductor.

Accordingly, Applicants respectfully submit that Claim 25 is not anticipated by Dubin. Claims 11-13, which include all of the limitations of Claim 25, are also not anticipated by Dubin. Applicants therefore request withdrawal of this rejection.

Rejection of Claim 10 under 35 U.S.C. §103(a) over Dubin in view of Jain

Claim 10 is rejected under 35 U.S.C. §103(a) as being unpatentable over Dubin in view of U.S. Patent No. 5,821,168 to Jain. Applicants respectfully traverse this rejection.

Claim 10 depends from Claim 25, which is directed to an interconnect structure formed on a substrate. It is a feature of the present invention that a first conductive liner is disposed on an underside and sidewalls of both a first portion and a second portion of the second conductor, while a second liner is disposed on an underside and sidewalls of only the first portion of the second conductor. Applicants respectfully submit that this feature of the present invention is neither disclosed nor suggested by Dubin in view of Jain, as follows.

As discussed previously, Dubin fails to disclose or even suggest the above-identified feature of the invention. Jain fails to remedy the deficiencies of the Dubin teaching in this regard. The Jain patent is directed to a process for forming a semiconductor device, in which an insulating layer is nitrided and then covered by a thin adhesion layer before depositing a composite copper layer. Figure 9 of Jain shows a damascene interconnect structure which is very similar to that of Dubin's Figure 2. Specifically, conductor 74 is shown surrounded on the underside and sidewalls only by adhesion layer 58. Notably, this is the only layer disposed on the underside and sidewalls of all portions of conductor 74, with no distinction between a first portion and a second portion. Jain, therefore, fails to provide any motivation to modify the teaching of Dubin in this regard.

Accordingly, Applicants respectfully submit that Claim 25 is patentable over Dubin in view of Jain. Claim 10, which includes all of the limitations of Claim 25, is also patentable over Dubin in view of Jain. Applicants therefore request withdrawal of this rejection.

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Rejection of Claim 14 under 35 U.S.C. §103(a) over Dubin in view of Omura

Claim 14 is rejected under 35 U.S.C. §103(a) as being unpatentable over Dubin in view of U.S. Patent No. 6,028,362 to Omura. Applicants respectfully traverse this rejection.

Claim 14 depends from Claim 25, which is directed to an interconnect structure formed on a substrate. It is a feature of the present invention that a first conductive liner is disposed on an underside and sidewalls of both a first portion and a second portion of the second conductor, while a second liner is disposed on an underside and sidewalls of only the first portion of the second conductor. Applicants respectfully submit that this feature of the present invention is neither disclosed nor suggested by Dubin in view of Omura, as follows.

As discussed previously, Dubin fails to disclose or even suggest the above-identified feature of the invention. Omura fails to remedy the deficiencies of the Dubin patent in this regard. The Omura patent is directed to damascene wiring structures with a flat surface. In several of the Omura views, such as in Figure 11, conductor 52 is surrounded on an underside and sidewalls by adhesion layer 50, and conductor 44 is surrounded on an underside and sidewalls by barrier layer 54. Thus, Omura discloses a first liner (e.g., 54) disposed on an underside and sidewalls of both a first portion and a second portion of a conductor (e.g., 44), but none of the Omura views show a second liner disposed on an underside and sidewalls of only the first portion of the conductor. Omura, therefore, fails to provide motivation to modify the teaching of Dubin in this regard.

Accordingly, Applicants respectfully submit that Claim 25 is patentable over Dubin in view of Omura. Claim 14, which includes all of the limitations of Claim 25, is also patentable over Dubin in view of Omura. Applicants therefore request withdrawal of this rejection.

Conclusion

Applicants respectfully submit that the present application is now in condition for allowance. If the Examiner has any questions or believes further discussion will aid examination and advance prosecution of the application, a telephone call to the undersigned is invited.

No fee is believed to be due for the submission of this amendment. If any fees are due, however, the Commissioner is authorized to charge such fees to Deposit Account No. 09-0458.

Respectfully Submitted,

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